1-1961

A study investigating the change in phorias due to sequential repetition from base in and base out direction using the Von Graefe and Maddox rod techniques at far and near

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Abstract

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Degree Type

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Committee Chair

D.T. Jans

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Optometry

A STUDY INVESTIGATING THE CHANGE IN PHORIAS DUE TO SEQUENTIAL REPETITION FROM BASE IN AND BASE OUT DIRECTION USING THE VON GRAEFE AND MADDOX ROD TECHNIQUES AT FAR AND NEAR.

CLINICAL YEAR THESIS

JANUARY 1961

BY

DENNIS MC CONNELL

and

CHARLES SIMPSON

ACKNOWLEDGEMENT:

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INTRODUCTION

This thesis is a comparison study of phoria changes as a result of a series of three phorias taken in sequence. Each of these series of phorias were grouped as follows: From excessive base in and base out directions, to alignment, at far and near using both the von Graefe and Maddox rod techniques on fifty two subjects.*

* Harrier and Kautz - A comparison study between the von Graefe and Maddox rod phoria techniques at far and near: Thesis January 1960.

APPARATUS

American optical Rx Master Refractor

Bausch and Lomb projector

Reduced Snellen Chart

Near Maddox rod target

Interpupillary distance millimeter rule

Light meter

PROCEDURE

"The original investigators worked with fifty two subjects most of whom were clinicians at Pacific University Optometric Clinic. Each subject was instructed to wear his habitual prescription during the testing, in case of a near add, the power of the add was put in the refractor for near tests. Each subject in this study was required to have 20/20 binocular acuity at far and near through his habitual prescription.

I. von Graefe diplopia technique:

A. At far - Target projected seventeen feet three inches from subject.
O.D. - Prism base in
O.S. - Prism base down
Target - Snellen Chart, 20/20
Room illumination - Full
Target illumination - 12 c.p.

B. At near - Target at sixteen inches from subject.
O.D. - Prism base in
O.S. - Prism base down
Target - Reduced Snellen Chart, bottom line of 20/20.
Room illumination - full
Target illumination - full

II. A. At far - Target projected seventeen feet three inches.
O. D. - Risley prism
O. S. - White Maddox rod, axis 180 degrees
Target - Projected white dot and vertical white line.
Room illumination - Dim
Target illumination - 12 c.p.

B. At near - Target sixteen inches from subject.
O.D. - Risley prism
O.S. - White Maddox rod axis 180 degrees
Target - 2.5mm. frosted glass pinhole illuminated from behind to give white dot and white vertical line.
Room illumination - Dim
Target illumination - 12 c.p."*

* Ibid., pp5-6

INSTRUCTIONS TO SUBJECTS

I. von Graefe Technique

Far - "Please read the top line of letters to yourself and tell me when the bottom line of letters passes directly underneath."

Near - "Please read the bottom line of the top target to yourself and tell me when the bottom target passes directly underneath."

II. Maddox Rod Technique

Far and Near - "Please look at the white line and Tell me when the white spot is directly on top of the line."

"It was necessary to use different room illumination levels for the two techniques. Full room illumination was used for the von Graefe technique to duplicate present clinical methods. Dim room illumination was required for the Maddox rod technique to provide a visible vertical line."

"Three readings were taken from excessive base in and three readings were taken from excessive base out using each technique at each distance. The subjects were allowed to regain binocularity between phoria readings in an attempt to eliminate any effects of time of dissociation. The same examiner did all measuring to eliminate errors of examiner technique."*

* Ibid., pp. 6-7

CRGANIZATION OF DATA

The data used in this thesis was accumulated by Harrier and Kautz for their thesis: "A comparison study between the von Graefe and Maddox rod phoria techniques ar far and near."*

Statistical Methods

Formulae

$$\sigma = \frac{i}{N}\sqrt{N(fd) - (\Sigma d)^2}$$

$$X = \frac{\Sigma x}{N}$$

Key

σ	Standard Deviation
f	Frequency Distribution
d	Distribution
X	Mean
N	Number of Subjects

* The original data can be acquired from the thesis copy in the office of Dr. Jans

STATISTICAL RESULTS OF THE GROUPING.

Maddox Rod from excessive base in at far:
Row I
X -0.278 Exo.
S.D. 3.155

Row II
X 0.112 Exo.
S.D. 2.730

Row III
X 0.067 Eso.
S.D. 2.827

von Graefe from excessive base in at far:
Row I
X 0.577Exo.
S.D. 2.327

Row II
X 0.601 Exo.
S.D. 2.461

Row III
X 0.601 Exo.
S.D. 2.730

Maddox Rod from excessive base out at far:
Row I
X 1.037 Eso.
S.D. 3.038

Row II
X 1.245 Eso
S.D. 2.460

Row III
X 1.341 Eso.
S.D. 1.921

von Graefe from excessive base out at far:
Row I
X 0.067 Exo.
S.D. 2.173

Row II
X 0.192 Eso.
S.D. 2.404

Row III
X 0.212 Exo.
S.D. 2.327

Maddox Rod from excessive base in at near:
Row I
X 6.264 Exo.
S.D. 5.288

Row II
X 5.870 Exo.
S.D. 5.154

Row III
X 5.585 Exo.
S.D. 5.192

von Graefe from excessive base in at near:
Row I
X 4.471 Exo.
S.D. 4.019

Row II
X 5.240 Exo.
S.D. 5.943

Row III
X 5.716 Exo.
S.D. 4.591

Maddox Rod from excessiv base out at near:
Row I
X 4.683 Exo.
S.D. 5.327

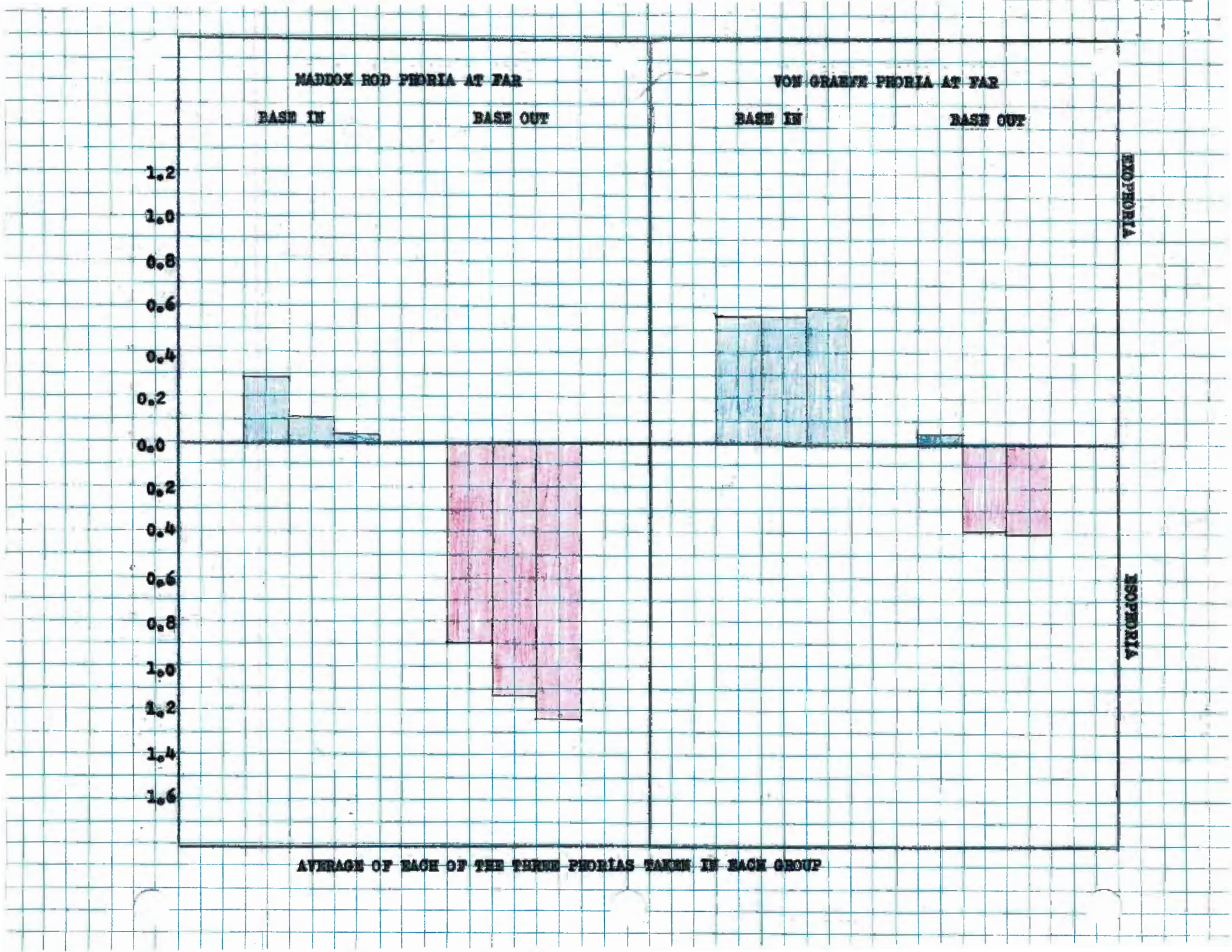
Row II
X 4.683 Exo.
S.D. 5.219

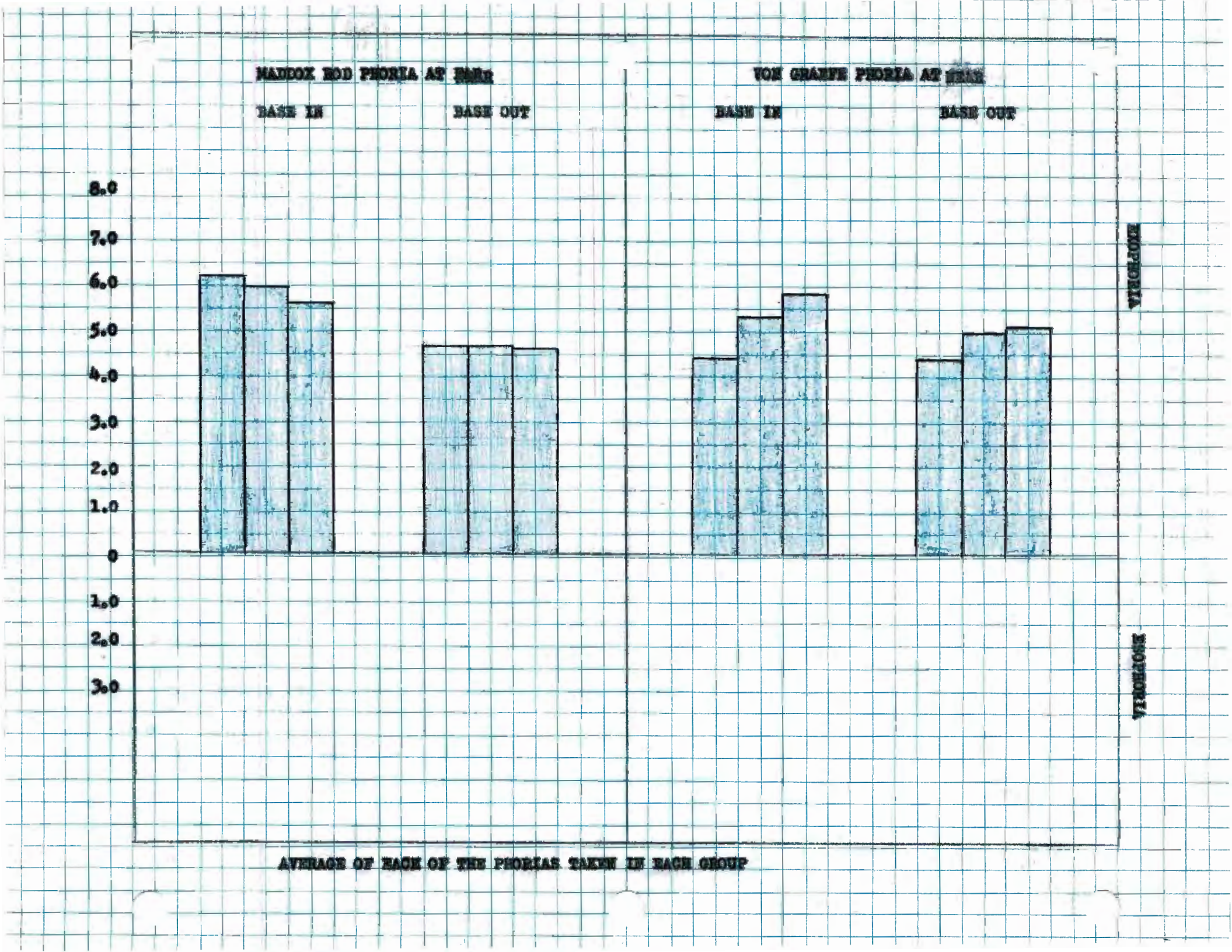
Row III
X 4.635 Exo.
S.D. 5.192

Von Graefe from excessive base out at near:
Row I
X 4.322Exo.
S.D. 4.307

Row II
X 4.913 Exo.
S.D. 4.153

Row III
X 5.037 Exo.
S.D. 4.461


MADDOX ROD PHORIA AT FAR
BASE IN
BASE OUT
VON GRAEFE PHORIA AT FAR
BASE IN
BASE OUT
EXOPHORIA
ESOPHORIA
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
AVERAGE OF EACH OF THE THREE PHORIAS TAKEN IN EACH GROUP


MADDOX ROD PHORIA AT [illegible]
BASE IN
BASE OUT
VON GRAEFE PHORIA AT [illegible]
BASE IN
BASE OUT
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
1.0
2.0
3.0
EXOPHORIA
ESOPHORIA
AVERAGE OF EACH OF THE PHORIAS TAKEN IN EACH GROUP

SUMMARY

The Maddox rod phorias at far, both base out and base in, progressed in an Eso. direction. The base in started in Exo. 0.278 standard deviation 3.155 and progressed into Eso. 0.067 standard deviation 2.827. The base out phorias, again at far, started in Eso. 1.037 standard deviation 3.038 and progressed towards greater Eso. 1.341 standard deviation 1.921.

The von Graefe phorias at far from excessive base in direction started in Exo. 0.577 standard deviation 2.327 and increased in Exo. 0.601 standard deviation 2.730. The phorias from the base out direction started in Exo. 0.067 standard deviation 2.173 and progressed into Eso. 0.212 standard deviation 2.327.

At near, the Maddox rod test from base in and base out progressed towards Eso. The base in started with 6.264 Exo. standard deviation 5.288 and progressed to 5.585 Exo. standard deviation 5.192. The base out was 4.683 Exo. standard deviation 5.327 to 4.635 Exo. standard deviation 5.192.

The von Graefe tests became more Exo. in both base in and base out. The first phoria from excessive base in was 4.471 Exo. standard deviation 4.019 to the third phoria of 5.716 Exo. standard deviation 4.591. The base out began at 4.322 Exo. standard deviation 4.307 and increased in Exo. to 5.037 standard deviation 4.461.

This thesis indicates that phorias, on repition do change. The Maddox rod phorias, far and near, base in or base out; progress in an esophoric direction. The von Graefe phorias, on the other hand, vary in direction of change. At far, from excessive base in, the phorias increase in exophoria. The phorias taken from excessive base out progress into esophoria. The phorias taken at near, base in or base out, show an increase in the exophoric direction.

APPENDIX I

MADDOX ROD AT FAR
FROM EXCESSIVE BASE OUT

	ROW I	ROW II	ROW III
1.	1.0 ESO	1.5 ESO	1.5 ESO
2.	1.0 ESO	1.5 ESO	2.0 ESO
3.	2.0 EXO	1.5 EXO	1.0 EXO
4.	0.5 EXO	1.5 EXO	2.0 EXO
5.	2.5 ESO	3.0 ESO	3.5 ESO
6.	0.5 ESO	0.5 ESO	1.5 ESO
7.	3.0 ESO	3.0 ESO	4.0 ESO
8.	4.0 ESO	4.0 ESO	5.0 ESO
9.	⊖	⊖	⊖
10.	3.0 EXO	4.0 EXO	4.0 EXO
11.	4.0 ESO	3.0 ESO	4.0 ESO
12.	2.5 ESO	3.0 ESO	3.0 ESO
13.	1.5 ESO	2.0 ESO	2.5 ESO
14.	2.5 EXO	2.0 EXO	2.0 EXO
15.	2.0 EXO	2.0 EXO	2.0 EXO
16.	7.0 ESO	6.5 ESO	7.0 ESO
17.	3.0 ESO	2.5 ESO	2.0 ESO
18.	2.5 EXO	2.0 EXO	1.5 EXO
19.	2.5 ESO	1.5 ESO	2.0 ESO
20.	0.5 EXO	⊖	0.5 EXO
21.	1.5 ESO	1.5 ESO	3.0 ESO
22.	1.0 ESO	2.0 ESO	3.0 ESO
23.	0.5 ESO	0.5 ESO	0.5 ESO
24.	1.5 ESO	1.0 ESO	1.5 ESO
25.	0.5 ESO	0.5 ESO	⊖
26.	3.0 EXO	2.0 EXO	2.0 EXO

VON GRAEFE AT FAR
FROM EXCESSIVE BASE OUT

	ROW I	ROW II	ROW III
1.	1.0 EXO	1.0 EXO	1.0 EXO
2.	0.5 ESO	1.0 ESO	1.5 ESO
3.	2.0 EXO	2.0 EXO	3.0 EXO
4.	2.0 EXO	2.0 EXO	1.5 EXO
5.	2.0 ESO	2.5 ESO	1.5 ESO
6.	0.5 EXO	0.5 EXO	0.5 EXO
7.	2.0 ESO	2.0 ESO	3.5 ESO
8.	0.5 EXO	0.5 EXO	0.5 EXO
9.	⊖	⊖	⊖
10.	2.0 EXO	2.5 EXO	2.0 EXO
11.	3.0 ESO	2.0 ESO	3.0 ESO
12.	1.5 ESO	2.0 ESO	2.0 ESO
13.	1.0 ESO	1.5 ESO	0.5 ESO
14.	2.0 EXO	1.5 EXO	2.0 ESO
15.	4.0 EXO	4.5 EXO	4.0 EXO
16.	5.5 ESO	6.0 ESO	6.0 ESO
17.	3.5 ESO	4.0 ESO	4.0 ESO
18.	2.0 EXO	1.5 EXO	2.5 EXO
19.	⊖	⊖	0.5 ESO
20.	⊖	1.0 ESO	1.0 ESO
21.	2.5 EXO	0.5 EXO	1.5 EXO
22.	2.0 ESO	1.5 ESO	1.0 ESO
23.	0.5 ESO	0.5 ESO	0.5 ESO
24.	0.5 EXO	0.5 EXO	0.5 EXO
25.	⊖	0.5 ESO	0.5 ESO
26.	2.5 EXO	2.5 EXO	3.0 EXO

	MADDOX ROD AT FAR FROM EXCESSIVE BASE OUT			VON GRAEFE AT FAR FROM EXCESSIVE BASE OUT		
	ROW I	ROW LL	ROW III	ROW I	ROW LI	ROW III
27.	⊖	⊖	1.0 ESO	0.5 EXO	0.5 EXO	⊖
28.	1.5 EXO	1.5 EXO	1.5 EXO	2.5 EXO	2.5 EXO	2.5 EXO
29.	2.0 ESO	1.5 ESO	1.5 ESO	1.5 ESO	1.0 ESO	1.0 ESO
30.	2.5 ESO	4.5 ESO	4.0 ESO	0.5 ESO	2.0 ESO	0.5 ESO
31.	1.5 ESO	3.0 ESO	3.0 ESO	0.5 ESO	1.0 ESO	2.0 ESO
32.	1.5 ESO	1.5 ESO	2.0 ESO	1.0 ESO	1.0 ESO	0.5 ESO
33.	1.0 ESO	1.0 ESO	1.0 ESO	1.0 EXO	0.5 EXO	⊖
34.	1.0 ESO	1.0 ESO	⊖	1.0 EXO	1.0 EXO	1.0 EXO
35.	1.0 ESO	2.0 ESO	1.0 ESO	1.5 ESO	1.5 ESO	1.0 EXO
36.	2.0 EXO	1.5 EXO	1.0 EXO	0.5 EXO	0.5 EXO	0.5 EXO
37.	3.0 ESO	3.0 ESO	2.5 ESO	1.0 ESO	1.5 ESO	1.0 ESO
38.	3.0 ESO	2.5 ESO	3.0 ESO	1.5 ESO	2.0 ESO	2.5 ESO
39.	⊖	0.5 ESO	0.5 ESO	1.0 EXO	1.0 EXO	1.0 EXO
40.	0.5 EXO	⊖	0.5 ESO	1.5 EXO	1.0 EXO	1.0 EXO
41.	7.0 ESO	7.0 ESO	6.5 ESO	6.0 ESO	6.0 ESO	6.0 ESO
42.	3.0 ESO	3.0 ESO	2.5 ESO	2.5 ESO	2.0 ESO	2.0 ESO
43.	1.5 ESO	1.5 ESO	1.0 ESO	1.0 EXO	1.0 EXO	0.5 EXO
44.	2.0 EXO	1.0 EXO	2.0 EXO	4.0 EXO	3.0 EXO	4.0 EXO
45.	3.5 ESO	2.5 ESO	2.5 ESO	1.0 ESO	2.0 ESO	2.5 ESO
46.	4.0 ESO	4.5 ESO	4.5 ESO	0.5 ESO	1.0 ESO	1.0 ESO
47.	1.5 ESO	1.5 ESO	1.0 ESO	1.0 EXO	1.0 ESO	1.0 EXO
48.	⊖	1.0 EXO	0.5 EXO	1.0 EXO	1.0 EXO	1.0 EXO
49.	1.0 EXO	1.5 EXO	1.5 EXO	1.0 EXO	1.5 EXO	1.5 EXO
50.	1.5 EXO	⊖	1.0 EXO	3.0 EXO	1.5 EXO	1.5 EXO
51.	6.0 ESO	5.0 ESO	6.0 ESO	2.5 ESO	3.5 ESO	3.5 EXO
52.	⊖	1.0 EXO	⊖	3.0 EXO	1.0 EXO	1.5 EXO

MADDOX ROD AT FAR
FROM EXCESSIVE BASE IN

	ROW I	ROW II	ROW III
1.	1.0 EXO	1.5 EXO	1.0 EXO
2.	1.5 ESO	1.0 ESO	1.5 ESO
3.	3.0 EXO	1.5 EXO	2.0 EXO
4.	1.5 EXO	2.5 EXO	2.5 EXO
5.	2.0 ESO	3.0 ESO	3.0 ESO
6.	0.5 ESO	0.5 ESO	1.0 ESO
7.	4.0 ESO	3.0 ESO	4.0 ESO
8.	2.0 ESO	2.0 ESO	3.0 ESO
9.	⊖	⊖	⊖
10.	4.0 EXO	5.0 EXO	6.0 EXO
11.	4.0 ESO	3.0 ESO	4.0 ESO
12.	2.0 ESO	1.5 ESO	3.0 ESO
13.	2.5 ESO	2.0 ESO	1.0 ESO
14.	2.0 EXO	2.5 EXO	2.5 EXO
15.	4.0 EXO	5.0 EXO	4.5 EXO
16.	7.5 ESO	6.5 ESO	6.0 ESO
17.	2.5 ESO	2.5 ESO	2.0 ESO
18.	3.0 EXO	2.5 EXO	2.5 EXO
19.	1.0 ESO	1.5 ESO	1.5 ESO
20.	4.0 EXO	4.0 EXO	4.5 EXO
21.	2.5 EXO	1.5 EXO	0.5 ESO
22.	1.0 EXO	0.5 ESO	⊖
23.	0.5 EXO	⊖	0.5 ESO
24.	0.5 EXO	0.5 ESO	0.5 ESO
25.	1.5 EXO	2.0 EXO	0.5 EXO
26.	4.0 EXO	3.0 EXO	2.5 EXO

VON GRAEFE AT FAR
FROM EXCESSIVE BASE IN

	ROW I	ROW II	ROW III
1.	2.5 EXO	2.5 EXO	2.5 EXO
2.	⊖	⊖	⊖
3.	4.0 EXO	3.5 EXO	3.0 EXO
4.	2.0 EXO	2.0 EXO	2.0 EXO
5.	1.5 ESO	2.0 ESO	1.5 ESO
6.	0.5 EXO	0.5 EXO	0.5 EXO
7.	1.0 ESO	2.0 ESO	2.5 ESO
8.	2.0 EXO	2.0 EXO	1.5 EXO
9.	1.0 ESO	1.0 ESO	1.0 ESO
10.	3.0 EXO	2.5 EXO	2.0 EXO
11.	3.0 ESO	2.5 ESO	2.5 ESO
12.	1.5 ESO	1.5 ESO	1.5 ESO
13.	⊖	⊖	3.0 EXO
14.	3.0 EXO	2.5 EXO	2.0 EXO
15.	4.0 EXO	5.0 EXO	4.5 EXO
16.	4.0 ESO	6.5 ESO	5.5 ESO
17.	3.0 ESO	3.0 ESO	3.0 ESO
18.	2.0 EXO	3.0 EXO	3.0 EXO
19.	0.5 EXO	1.0 EXO	0.5 EXO
20.	1.0 EXO	3.0 EXO	3.0 EXO
21.	2.5 EXO	3.0 EXO	2.5 EXO
22.	0.5 EXO	2.0 EXO	3.0 EXO
23.	0.5 ESO	⊖	1.0 ESO
24.	⊖	0.5 EXO	0.5 EXO
25.	1.0 EXO	1.0 EXO	0.5 EXO
26.	2.5 EXO	2.5 EXO	3.0 EXO

	MADDOX ROD AT FAR FROM EXCESSIVE BASE IN			VON GRAEFE AT FAR FROM EXCESSIVE BASE IN		
	ROW I	ROW LL	ROW III	ROW I	ROW LI	ROW III
27.	1.0 EXO	0.5 EXO	1.0 EXO	1.0 EXO	0.5 EXO	0.5 EXO
28.	3.0 EXO	2.5 EXO	3.0 EXO	3.0 EXO	3.5 EXO	3.5 EXO
29.	ϴ	0.5 EXO	0.5 ESO	0.5 EXO	0.5 ESO	0.5 ESO
30.	2.0 ESO	4.5 ESO	3.5 ESO	0.5 EXO	1.0 EXO	ϴ
31.	1.0 ESO	2.0 ESO	2.5 ESO	ϴ	0.5 ESO	1.5 ESO
32.	ϴ	0.5 EXO	ϴ	0.5 ESO	ϴ	0.5 ESO
33.	ϴ	ϴ	1.0 EXO	1.5 EXO	1.5 EXO	1.0 EXO
34.	ϴ	0.5 ESO	1.5 EXO	1.5 EXO	1.0 EXO	2.5 EXO
35.	1.0 EXO	1.0 EXO	0.5 EXO	2.0 EXO	1.5 EXO	1.0 EXO
36.	3.0 EXO	3.0 EXO	3.0 EXO	1.0 EXO	1.0 EXO	1.0 EXO
37.	1.0 ESO	2.0 ESO	1.5 ESO	1.5 ESO	1.5 ESO	ϴ
38.	1.5 ESO	1.5 ESO	2.0 ESO	2.5 ESO	1.5 ESO	1.5 ESO
39.	2.0 EXO	0.5 ESO	1.5 EXO	1.5 EXO	1.5 EXO	1.0 EXO
40.	1.5 EXO	1.0 EXO	0.5 EXO	2.0 EXO	4.0 EXO	2.0 EXO
41.	6.0 ESO	6.5 ESO	6.5 ESO	6.0 ESO	7.0 ESO	7.0 ESO
42.	1.5 ESO	2.0 ESO	2.5 ESO	2.0 ESO	2.0 ESO	2.0 ESO
43.	ϴ	1.0 ESO	1.0 ESO	2.0 EXO	3.0 EXO	1.0 EXO
44.	2.0 EXO	2.0 EXO	2.0 EXO	3.0 EXO	4.0 EXO	4.0 EXO
45.	2.5 ESO	ϴ	0.5 ESO	0.5 EXO	2.0 ESO	0.5 ESO
46.	3.5 ESO	3.0 ESO	2.0 ESO	ϴ	1.0 ESO	1.0 ESO
47.	1.0 EXO	1.5 EXO	1.0 EXO	1.0 EXO	1.0 EXO	1.5 EXO
48.	1.5 EXO	1.5 EXO	1.5 EXO	1.5 EXO	1.5 EXO	1.5 EXO
49.	1.0 EXO	1.5 EXO	2.5 EXO	2.0 EXO	2.5 EXO	2.5 EXO
50.	2.0 EXO	2.5 EXO	2.0 EXO	1.5 EXO	2.0 EXO	2.0 EXO
51.	3.0 ESO	3.5 ESO	4.0 ESO	2.5 ESO	3.5 ESO	3.0 ESO
52.	2.0 EXO	6.0 EXO	2.0 EXO	5.0 EXO	3.0 EXO	3.5 EXO

MADDOX ROD AT NEAR
FROM EXCESSIVE BASE OUT

	ROW I	ROW II	ROW III
1.	1.0 EXO	1.0 EXO	1.0 EXO
2.	6.0 EXO	6.0 EXO	6.0 EXO
3.	10.5 EXO	10.0 EXO	9.0 EXO
4.	8.0 EXO	8.5 EXO	8.5 EXO
5.	9.0 EXO	8.0 EXO	7.0 EXO
6.	2.0 EXO	2.0 EXO	2.5 EXO
7.	7.5 EXO	7.5 EXO	8.0 EXO
8.	3.0 ESO	3.0 ESO	4.0 ESO
9.	8.0 EXO	9.0 EXO	9.0 EXO
10.	9.0 EXO	8.0 EXO	8.5 EXO
11.	8.0 EXO	7.5 EXO	8.0 EXO
12.	1.0 ESO	⊖	⊖
13.	2.0 ESO	2.5 ESO	1.5 ESO
14.	15.0 EXO	15.0 EXO	14.0 EXO
15.	12.5 EXO	13.0 EXO	13.0 EXO
16.	⊖	⊖	0.5 EXO
17.	1.0 EXO	0.5 EXO	0.5 EXO
18.	17.0 EXO	16.0 EXO	16.5 EXO
19.	7.5 ESO	7.5 ESO	9.0 ESO
20.	9.0 EXO	6.0 EXO	6.0 EXO
21.	13.0 EXO	8.5 EXO	8.0 EXO
22.	3.0 ESO	⊖	⊖
23.	10.5 EXO	9.0 EXO	8.5 EXO
24.	1.0 EXO	4.0 EXO	2.0 EXO
25.	10.5 EXO	10.5 EXO	9.0 EXO
26.	0.5 ESO	0.5 EXO	0.5 EXO

VON GRAEFE AT NEAR
FROM EXCESSIVE BASE OUT

	ROW I	ROW II	ROW III
1.	4.5 EXO	4.0 EXO	4.0 EXO
2.	4.5 EXO	5.5 EXO	6.0 EXO
3.	11.0 EXO	10.5 EXO	10.5 EXO
4.	10.5 EXO	10.5 EXO	11.0 EXO
5.	6.5 EXO	6.5 EXO	7.0 EXO
6.	6.0 EXO	6.5 EXO	6.5 EXO
7.	8.0 EXO	8.5 EXO	8.0 EXO
8.	2.0 EXO	1.0 EXO	2.0 EXO
9.	8.0 EXO	8.0 EXO	7.0 EXO
10.	6.0 EXO	7.5 EXO	6.5 EXO
11.	7.5 EXO	5.0 EXO	6.0 EXO
12.	2.5 EXO	2.5 EXO	2.5 EXO
13.	2.0 EXO	1.0 ESO	⊖
14.	11.0 EXO	9.0 EXO	10.0 EXO
15.	12.0 EXO	14.5 EXO	14.0 EXO
16.	1.0 ESO	0.5 ESO	⊖
17.	1.0 EXO	0.5 EXO	⊖
18.	12.0 EXO	13.5 EXO	12.5 EXO
19.	6.0 ESO	7.0 ESO	9.0 ESO
20.	3.0 EXO	4.0 EXO	6.0 EXO
21.	9.5 EXO	10.5 EXO	12.0 EXO
22.	1.5 EXO	3.0 EXO	3.0 EXO
23.	1.5 EXO	2.5 EXO	6.5 EXO
24.	7.0 EXO	8.5 EXO	8.0 EXO
25.	9.5 EXO	10.0 EXO	10.5 EXO
26.	3.5 EXO	5.0 EXO	8.0 EXO

	MADDOX ROD AT NEAR FROM EXCESSIVE BASE OUT			VON GRAEFE AT NEAR FROM EXCESSIVE BASE OUT		
	ROW I	ROW LL	ROW III	ROW I	ROW LI	ROW III
27.	4.0 EXO	5.0 EXO	4.0 EXO	1.5 EXO	ϴ	1.0 EXO
28.	2.0 ESO	2.0 EXO	3.0 EXO	3.5 EXO	4.0 EXO	3.0 EXO
29.	1.0 EXO	ϴ	0.5 EXO	3.0 ESO	2.5 ESO	3.0 ESO
30.	3.0 EXO	3.0 EXO	4.0 EXO	4.0 EXO	3.5 EXO	4.5 EXO
31.	3.0 EXO	2.5 EXO	3.0 EXO	ϴ	1.0 EXO	1.5 EXO
32.	5.0 EXO	6.0 EXO	6.5 EXO	4.0 EXO	4.5 EXO	4.5 EXO
33.	4.0 EXO	5.0 EXO	4.5 EXO	6.5 EXO	5.0 EXO	9.5 EXO
34.	3.0 EXO	2.5 EXO	4.0 ESO	5.0 EXO	5.5 EXO	4.0 EXO
35.	11.0 EXO	4.0 EXO	ϴ	5.0 EXO	5.5 EXO	6.5 EXO
36.	9.0 EXO	6.0 EXO	8.0 EXO	9.0 EXO	8.5 EXO	9.0 EXO
37.	1.5 EXO	ϴ	ϴ	2.0 ESO	1.0 ESO	1.0 ESO
38.	7.0 EXO	9.0 EXO	9.0 EXO	5.0 EXO	7.0 EXO	7.0 EXO
39.	7.0 EXO	9.5 EXO	8.0 EXO	8.0 EXO	7.0 EXO	6.0 EXO
40.	7.0 EXO	6.0 EXO	7.0 EXO	6.0 EXO	5.5 EXO	6.0 EXO
41.	5.0 ESO	3.0 ESO	1.5 ESO	4.0 ESO	2.0 ESO	3.0 ESO
42.	3.0 EXO	3.0 EXO	3.5 EXO	3.0 EXO	4.0 EXO	3.5 EXO
43.	7.0 EXO	7.0 EXO	7.0 EXO	5.0 EXO	6.0 EXO	6.0 EXO
44.	9.0 EXO	12.0 EXO	12.0 EXO	4.0 EXO	8.0 EXO	8.0 EXO
45.	3.0 EXO	9.0 EXO	4.5 EXO	0.5 EXO	0.5 EXO	ϴ
46.	ϴ	ϴ	ϴ	1.0 ESO	1.0 ESO	2.0 ESO
47.	3.0 EXO	3.0 EXO	3.0 EXO	4.0 EXO	4.0 EXO	4.0 EXO
48.	4.5 EXO	6.5 EXO	7.0 EXO	4.0 EXO	3.0 EXO	3.0 EXO
49.	4.0 EXO	6.0 EXO	6.0 EXO	5.0 EXO	5.0 EXO	7.0 EXO
50.	6.0 EXO	7.0 EXO	8.0 EXO	2.5 EXO	9.0 EXO	10.5 EXO
51.	3.0 ESO	2.0 ESO	2.0 ESO	ϴ	ϴ	1.0 EXO
52.	8.0 EXO	6.0 EXO	8.0 EXO	6.0 EXO	12.0 EXO	11.0 EXO

MADDOX ROD AT NEAR
FROM EXCESSIVE BASE IN

VON GRAEFE AT NEAR
FROM EXCESSIVE BASE IN

	ROW I	ROW II	ROW III	ROW I	ROW II	ROW III
1.	4.0 EXO	4.0 EXO	3.5 EXO	5.0 EXO	5.0 EXO	4.5 EXO
2.	6.5 EXO	6.5 EXO	6.5 EXO	4.5 EXO	4.5 EXO	5.0 EXO
3.	9.0 EXO	11.0 EXO	10.5 EXO	9.0 EXO	10.5 EXO	10.0 EXO
4.	10.5 EXO	11.0 EXO	9.5 EXO	9.0 EXO	11.5 EXO	12.5 EXO
5.	8.0 EXO	7.5 EXO	7.5 EXO	6.0 EXO	6.5 EXO	7.0 EXO
6.	2.0 EXO	2.0 EXO	2.0 EXO	4.5 EXO	6.0 EXO	6.5 EXO
7.	7.5 EXO	8.0 EXO	8.0 EXO	8.0 EXO	9.0 EXO	9.5 EXO
8.	1.0 EXO	1.0 ESO	2.0 ESO	5.0 EXO	5.0 EXO	6.0 EXO
9.	9.0 EXO	9.0 EXO	10.0 EXO	8.0 EXO	8.0 EXO	8.0 EXO
10.	8.0 EXO	10.0 EXO	9.0 EXO	7.0 EXO	7.5 EXO	7.0 EXO
11.	8.0 EXO	8.0 EXO	8.0 EXO	7.5 EXO	5.0 EXO	6.0 EXO
12.	Θ	1.0 EXO	1.0 EXO	2.0 EXO	2.5 EXO	3.0 EXO
13.	2.0 ESO	2.0 ESO	1.5 ESO	Θ	1.0 ESO	1.0 ESO
14.	16.0 EXO	16.0 EXO	16.0 EXO	10.0 EXO	12.0 EXO	8.0 EXO
15.	15.5 EXO	14.0 EXO	14.0 EXO	13.5 EXO	13.5 EXO	15.0 EXO
16.	1.5 ESO	1.5 ESO	0.5 ESO	1.0 ESO	Θ	0.5 ESO
17.	4.0 EXO	4.0 EXO	3.5 EXO	Θ	10.0 EXO	15.0 EXO
18.	19.0 EXO	17.0 EXO	17.0 EXO	13.0 EXO	14.0 EXO	15.5 EXO
19.	8.0 ESO	9.5 EXO	9.5 ESO	5.5 ESO	5.5 ESO	8.0 ESO
20.	7.0 EXO	7.5 EXO	8.0 EXO	4.5 EXO	6.5 EXO	7.0 EXO
21.	15.0 EXO	10.5 EXO	8.5 EXO	8.5 EXO	12.5 EXO	11.5 EXO
22.	4.0 EXO	5.0 EXO	4.0 EXO	Θ	5.5 EXO	4.0 EXO
23.	10.0 EXO	11.0 EXO	9.5 EXO	1.5 EXO	3.0 EXO	7.0 EXO
24.	11.0 EXO	6.0 EXO	6.0 EXO	7.0 EXO	7.5 EXO	8.5 EXO
25.	14.0 EXO	12.0 EXO	10.5 EXO	9.0 EXO	11.0 EXO	10.5 EXO
26.	Θ	0.5 EXO	1.5 EXO	4.5 EXO	5.0 EXO	4.5 EXO

	MADDOX ROD AT NEAR FROM EXCESSIVE BASE IN			VON GRAEFE AT NEAR FROM EXCESSIVE BASE IN		
	ROW I	ROW LL	ROW III	ROW I	ROW LI	ROW III
27.	6.0 EXO	6.0 EXO	4.5 EXO	2.0 EXO	3.0 EXO	3.0 EXO
28.	1.5 EXO	4.0 EXO	3.0 EXO	5.0 EXO	5.5 EXO	5.0 EXO
29.	2.5 EXO	4.5 EXO	3.5 EXO	1.0 EXO	1.5 ESO	2.0 EXO
30.	4.0 EXO	4.0 EXO	7.0 EXO	3.0 EXO	4.0 EXO	3.0 EXO
31.	5.0 EXO	4.0 EXO	4.0 EXO	0.5 ESO	1.0 EXO	1.0 EXO
32.	6.0 EXO	5.0 EXO	5.5 EXO	4.0 EXO	5.0 EXO	4.5 EXO
33.	9.0 EXO	11.0 EXO	10.5 EXO	5.0 EXO	6.5 EXO	6.0 EXO
34.	3.0 EXO	2.5 EXO	4.0 ESO	5.0 EXO	5.0 EXO	5.0 EXO
35.	11.0 EXO	4.0 EXO	Ø	5.5 EXO	6.0 EXO	8.0 EXO
36.	11.0 EXO	8.0 EXO	8.0 EXO	8.0 EXO	9.0 EXO	9.0 EXO
37.	1.5 EXO	1.0 EXO	2.0 EXO	2.0 ESO	2.0 ESO	Ø
38.	8.5 EXO	11.0 EXO	10.5 EXO	3.5 EXO	8.0 EXO	7.5 EXO
39.	11.5 EXO	11.5 EXO	9.0 EXO	7.0 EXO	8.0 EXO	6.5 EXO
40.	6.0 EXO	6.5 EXO	6.0 EXO	5.0 EXO	6.0 EXO	7.5 EXO
41.	4.0 ESO	3.0 ESO	2.0 ESO	3.0 ESO	5.0 ESO	3.0 ESO
42.	4.0 EXO	3.5 EXO	4.0 EXO	2.5 EXO	3.0 EXO	4.0 EXO
43.	7.0 EXO	7.0 EXO	7.0 EXO	6.0 EXO	6.0 EXO	5.0 EXO
44.	12.0 EXO	12.0 EXO	13.0 EXO	6.0 EXO	6.0 EXO	6.0 EXO
45.	3.0 EXO	4.5 EXO	6.0 EXO	0.5 EXO	0.5 EXO	1.0 EXO
46.	Ø	Ø	Ø	2.0 EXO	1.5 EXO	3.0 EXO
47.	2.0 EXO	2.0 EXO	2.0 EXO	2.5 EXO	4.0 EXO	3.0 EXO
48.	11.5 EXO	6.0 EXO	7.0 EXO	4.0 EXO	4.0 EXO	4.0 EXO
49.	3.0 EXO	6.0 EXO	7.0 EXO	5.5 EXO	6.0 EXO	6.0 EXO
50.	8.0 EXO	6.0 EXO	8.0 EXO	7.0 EXO	8.0 EXO	10.0 EXO
51.	Ø	0.5 ESO	0.5 ESO	Ø	1.0 EXO	1.0 EXO
52.	12.0 EXO	12. EXO	12.0 EXO	9.0 EXO	9.0 EXO	11.0 EXO